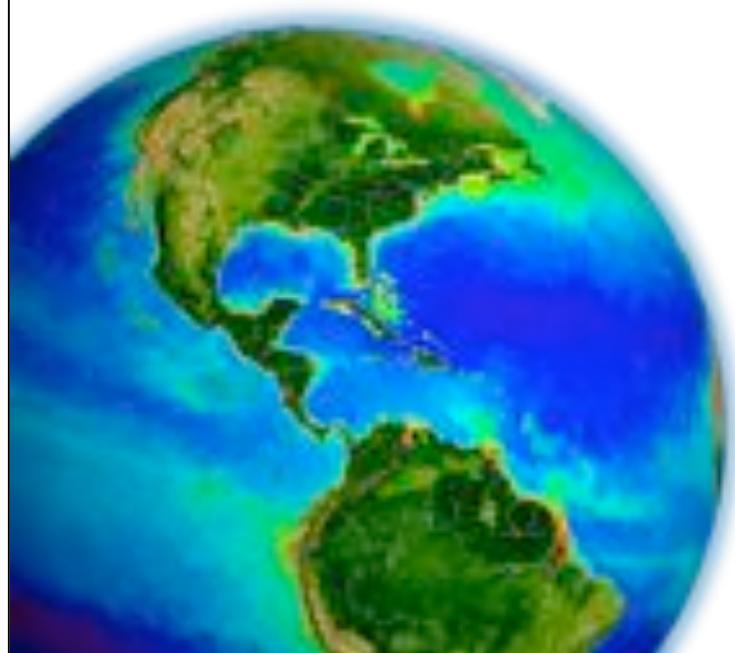


# NASA support for IOP data products

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## overview

priority has been to improve satellite radiometry

- reprocessing of SeaWiFS completed

- reprocessing of MODIS-Aqua near completion

framework for IOP data product production & evaluation improved

- algorithm support

- SeaDAS implementation

- analysis tools

## IOP algorithms supported by I2gen / SeaDAS

absorption ( $a_{ph}$ ,  $a_{dg}$ ) & backscattering ( $b_{bp}$ )

Maritorena et al. (2002) ~ GSM

Lee et al. (2002) ~ QAA

Smyth et al. (2006) ~ PML

Loisel & Stramski (2000) ~ LAS

Hoge & Lyon (1996) ~ HAL

Carder et al. (1999) ~ Carder

Kuchinke et al. (2009) ~ SOA

OOXIX IOP workshop ~ GIOP

diffuse attenuation ( $K_d$ ) & optical depths ( $Z_{\%}$ ,  $Z_{eu}$ )

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consensus to refine spectral optimization to initiate process

$$R_{rs} \approx func\left(\frac{b_b}{a + b_b}\right)$$



Spectral Optimization:

- \* define eigenvectors (shape functions) for bbp( $\lambda$ ), adg( $\lambda$ ), aph( $\lambda$ ), etc.
- \* optimized solution via Levenberg Marquardt, matrix inversion, etc.

our STARTING point:

- \* dynamic bbp retrieval
- \* dynamic aph spectral model
- \* IOP-based f/Q tables
- \* Raman scattering
- \* fluorescence
- \* T/S dependence on aw & bbw
- \* optical water class parameterization
- \* uncertainties & propagation of error

metrics defined to evaluate progress

# current implementation of the Generic IOP (GIOP) model

specify sensor wavelengths to fit

e.g., 412, 443, 490, 510, 555

select aph form & set params

tabulated:  $\text{aph}^*(\lambda)$

dynamic: Bricaud, Ciotti, Lee

select adg form & set params

exponential: S

dynamic: QAA, OBPG

select bbp form & set params

power law:  $\eta$

dynamic: QAA, Loisel, Ciotti, Morel

select rrs[0-] to bb / (a + bb)

quadratic

f/Q: Morel (tbd: PML, Lee)

specify inversion method

Levenburg-Marquardt

Amoeba (downhill simplex)

Lower-Upper Decomposition

Singular-Value Decomposition

specify output products

$a(\lambda)$ ,  $\text{aph}(\lambda)$ ,  $\text{adg}(\lambda)$ ,  $bb(\lambda)$ ,  $bbp(\lambda)$

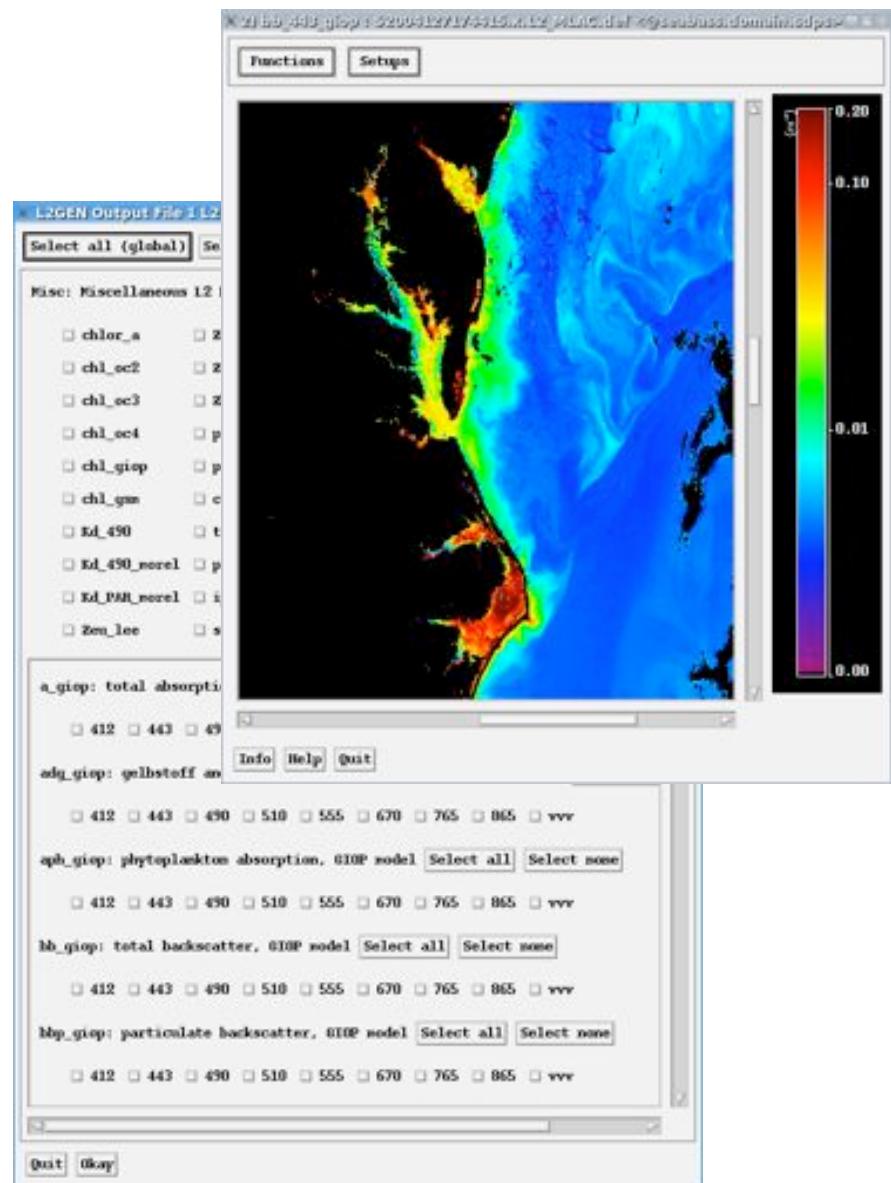
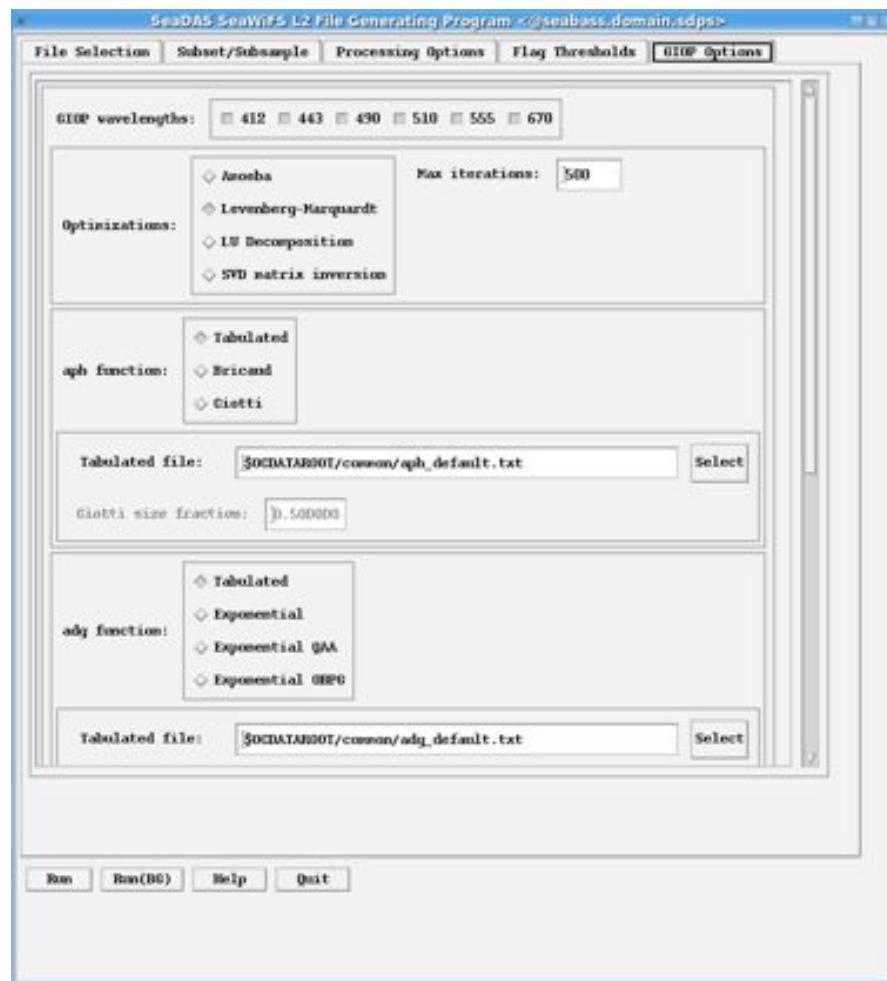
$\lambda$  = any sensor wavelength(s)

Chl (given  $\text{aph}^*(\lambda)$ )

$\eta$ , S (dynamic model params)

internal flags

# GIOP implementation in SeaDAS



<http://oceancolor.gsfc.nasa.gov/seadas/>

## to be implemented in GIOP

ability to specify multiple eigenvectors for bbp, adg, & aph

- split adg into ad & ag
- provide two  $\eta$  for bbp

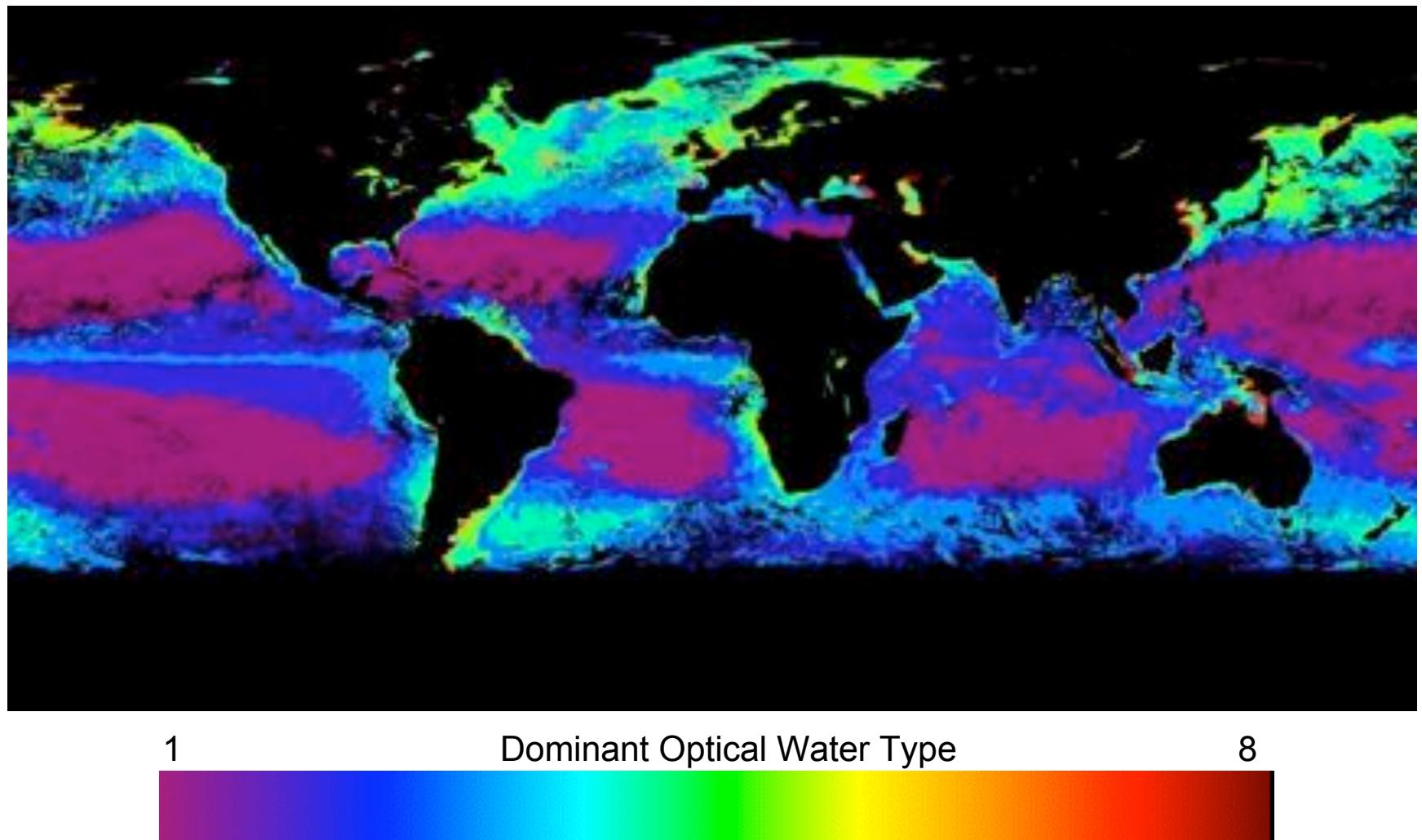
use  $\eta$  from Loisel & Stramski (2000)

consideration of uncertainty estimates

- Wang et al., Applied Optics (2005)
- Lee et al., Applied Optics (2010)
- Maritorena et al. & GlobeColour

province (e.g., OWT) switching

## optical water types (OWT)



Moore, T.S., et al., A class-based approach to characterizing and mapping the uncertainty of the MODIS ocean chlorophyll product, *Remote Sensing of Environment* (2009)

## analysis tools

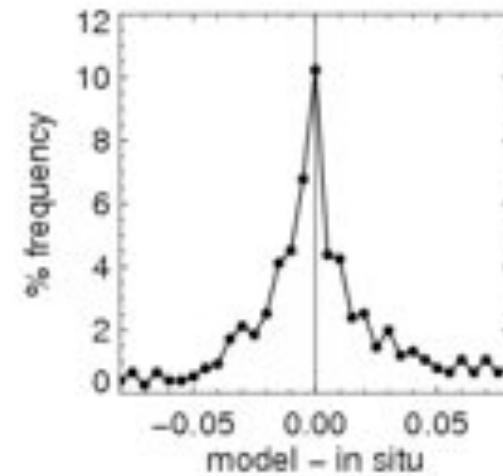
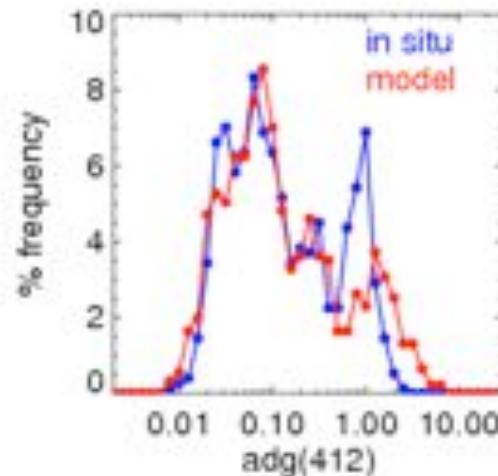
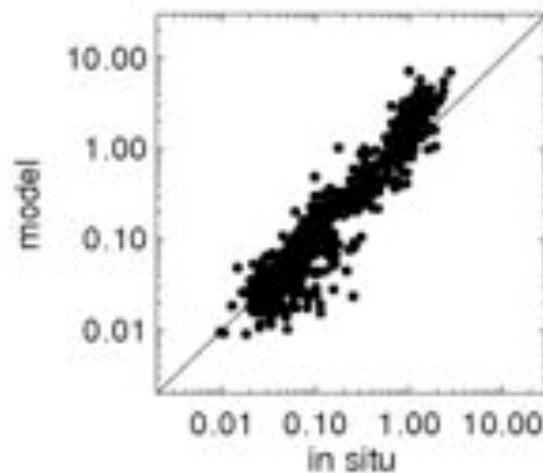
in situ data: scatter plots, freq. distributions

satellite data: scatter plots, freq. distributions

regional (Level-2): spatial coverage, time-series, freq. distributions

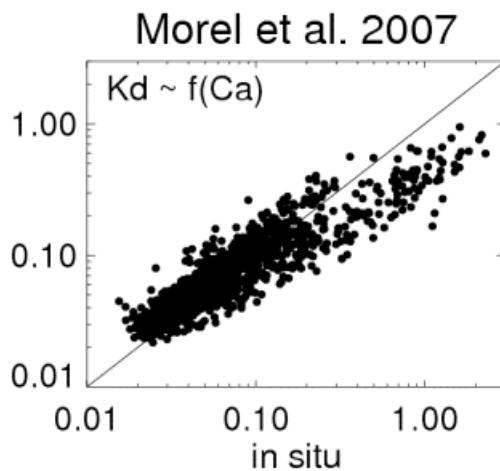
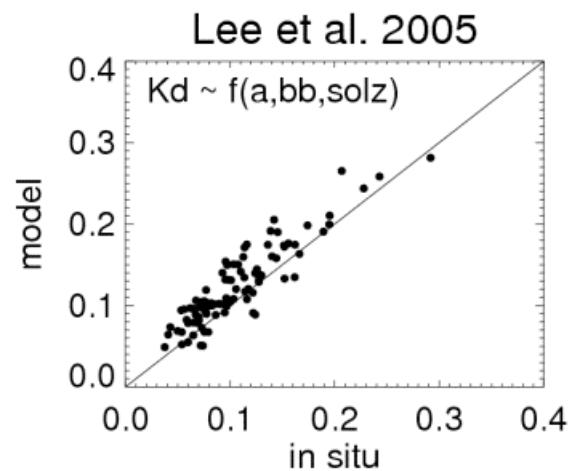
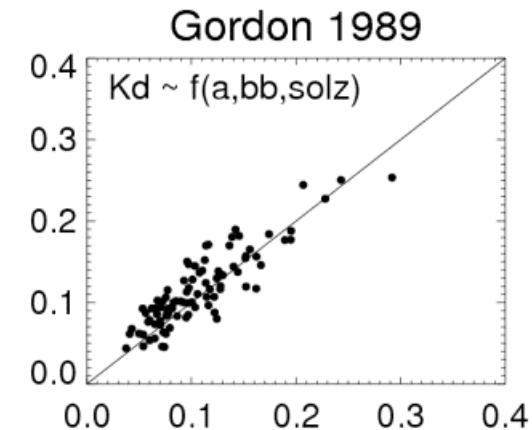
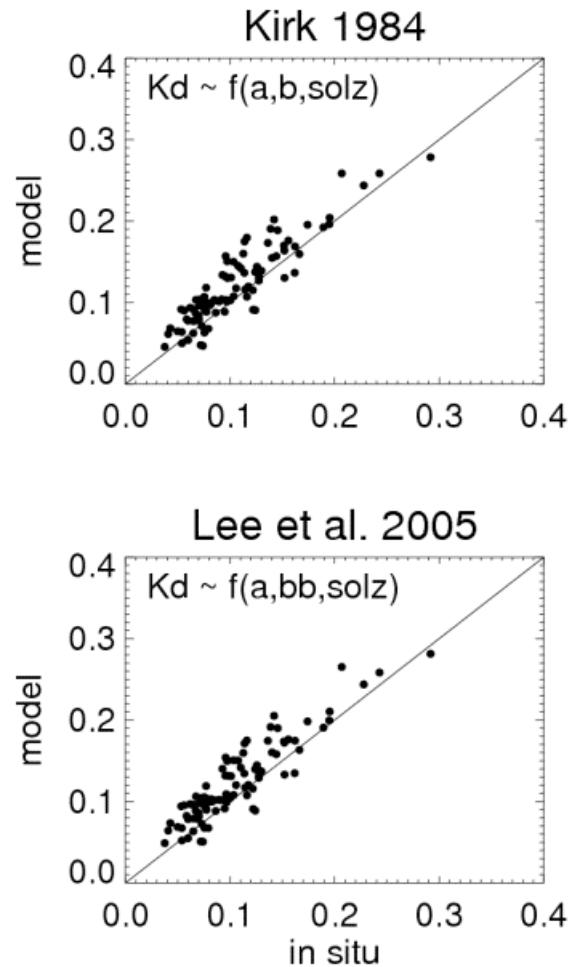
global (Level-3): spatial coverage, time-series, freq. distributions

$\text{adg}(412) \sim \text{in situ vs. modeled (using in situ Rrs)}$



# analysis tools

Kd(490) from NOMAD vs. popular models



## analysis tools

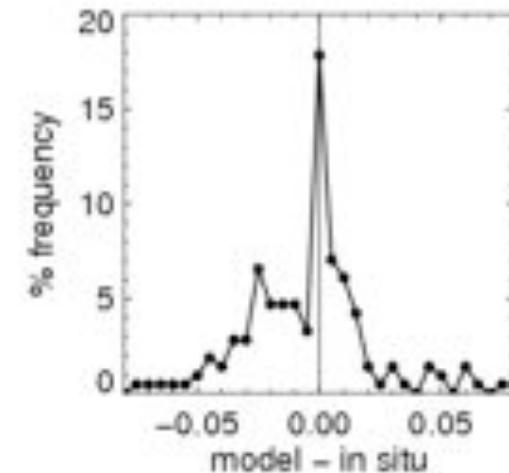
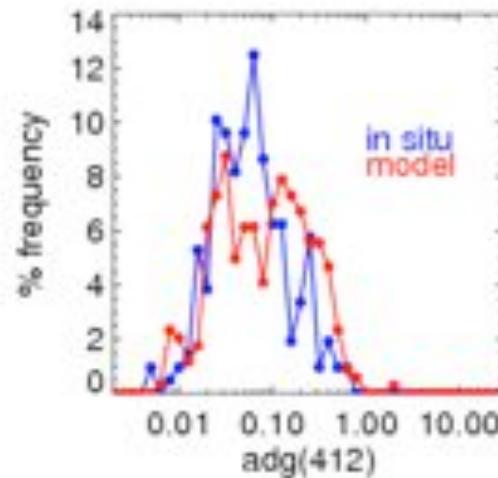
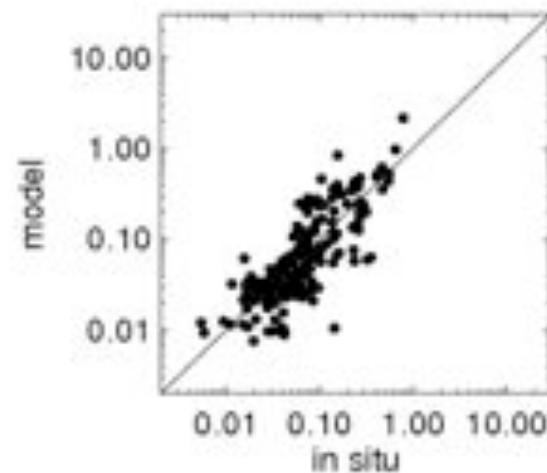
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**satellite data: scatter plots, freq. distributions**

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global (Level-3): spatial coverage, time-series, freq. distributions

adg(412) ~ in situ vs. modeled (using satellite Rrs)



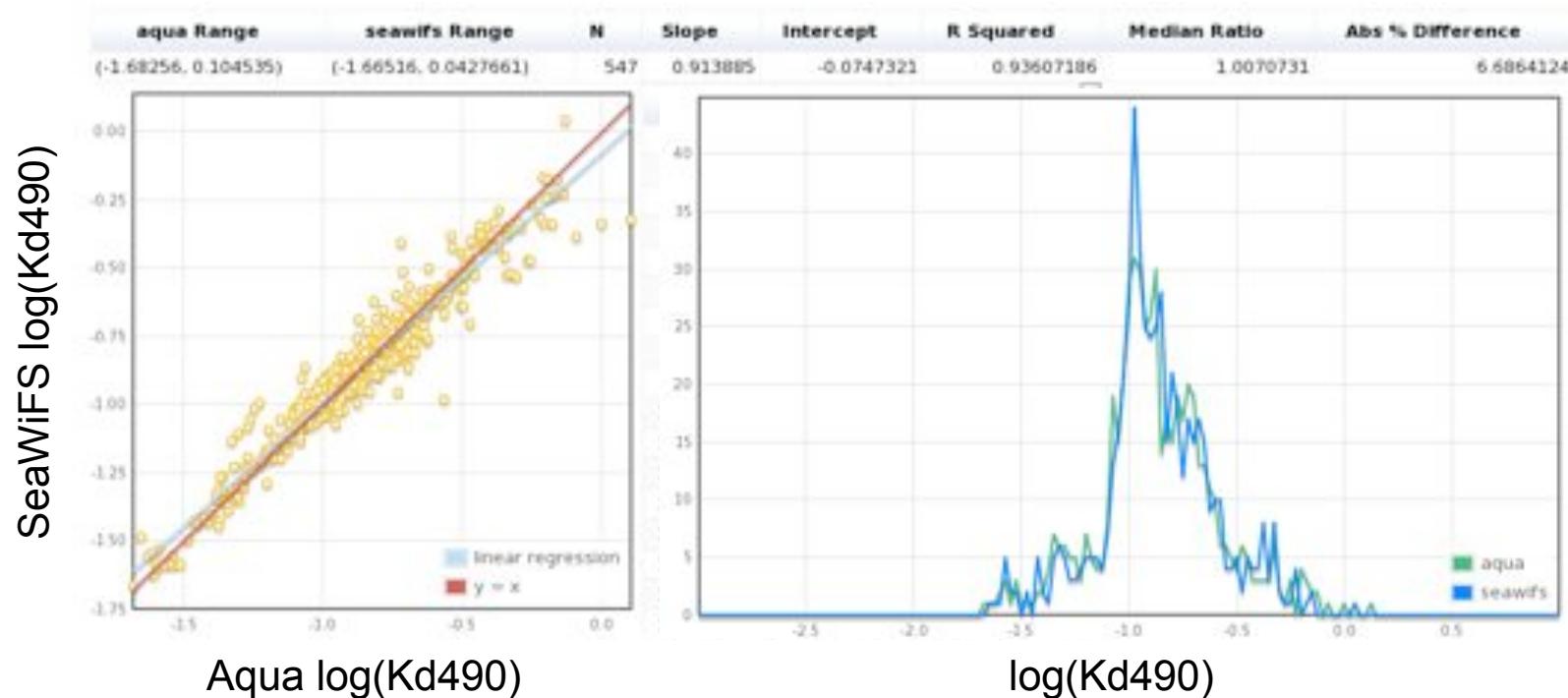
## analysis tools

“match-up” results publicly posted online at:

[http://seabass.gsfc.nasa.gov/seabasscgi/validation\\_search.cgi](http://seabass.gsfc.nasa.gov/seabasscgi/validation_search.cgi)

### highlights

- analyze match-ups for satellite-to-*in situ* & satellite-to-satellite
- search by date, location, water depth, or specific cruise
- customize exclusion criteria
- all operational data products



## analysis tools

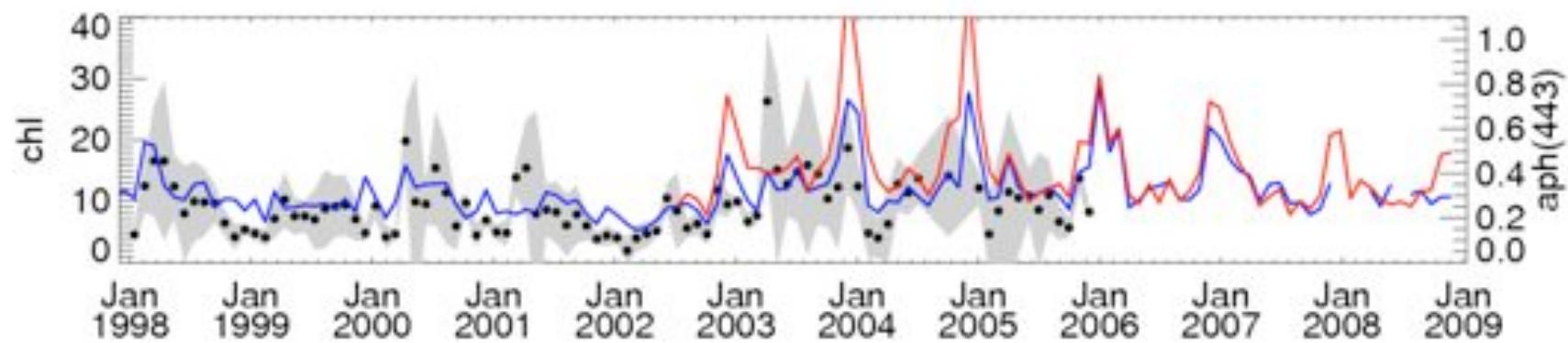
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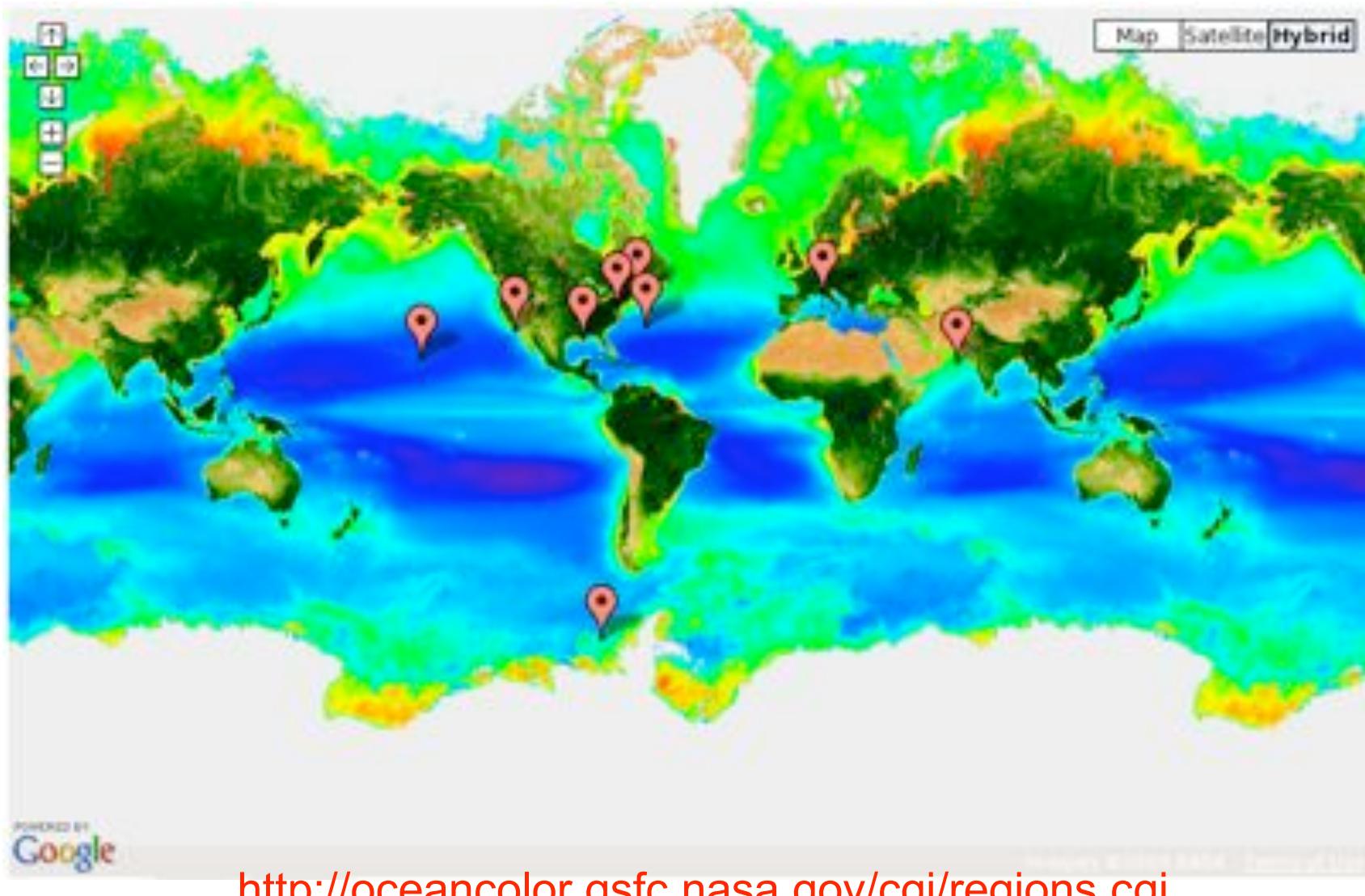
regional (Level-2): spatial coverage, time-series, freq. distributions

global (Level-3): spatial coverage, time-series, freq. distributions

monthly time-series of **SeaWiFS** & **Aqua**  $\text{aph}(443)$  vs in situ Chl  
in mid-Chesapeake Bay



## analysis tools



## analysis tools

in situ data: scatter plots, freq. distributions

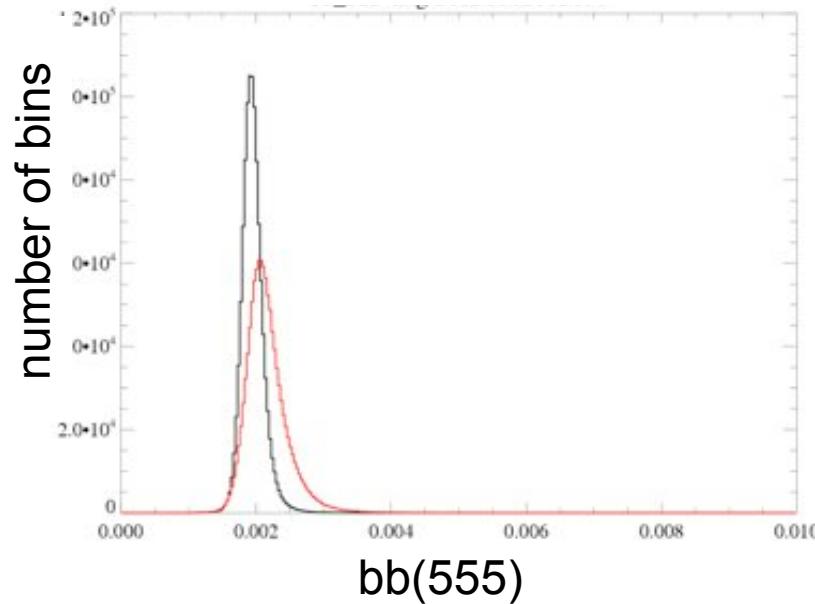
satellite data: scatter plots, freq. distributions

regional (Level-2): spatial coverage, time-series, freq. distributions

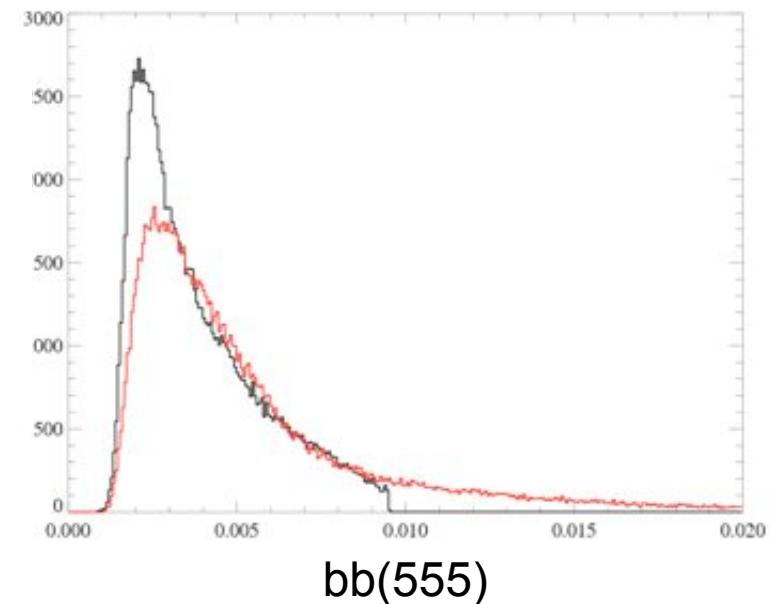
**global (Level-3): spatial coverage, time-series, freq. distributions**

SeaWiFS global Level-3 from 1 Mar 2005

oligotrophic subset



eutrophic subset



## analysis tools to be implemented

comparison of coverages @ Level-2 and -3

evaluation of uncertainties

analysis of retrievals @ various trophic levels / provinces / OWTs

all of the above on various temporal & spatial scales

thank you

# analysis tools

frequency distributions for IOP products in NOMAD

